JC07 Rec'd PCT/PTO 19 DEC 2001

FORM PTO-1390 (REV. 9-2001) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER: YAM 2 0013

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5): 10/018924

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP00/04166	23 June 2000	23 June 1999

TITLE OF INVENTION: COMPOSITION FOR PROMOTING PASSIVE EXTENSION OF BLADDER SMOOTH MUSCLE

APPLICANT(S) FOR DO/EO/US: YANAGITA, Toshihiko

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [X] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is attached hereto (required only if not communicated by the International Bureau).
   b. [X] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. [X] is attached hereto.
   b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   b. [ ] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [X] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] An English lanugage translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [X] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [ ] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [X] A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. [ ] A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. [ ] A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. [X] Other items or information:

Application Data Sheet
Sequence Listing (12 pages)
Verified Statement Under 37 CFR 1.821(f)

Express Mail Label No. EL 852683396 US
I hereby certify that this paper is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Laurie A. Boylan
(TYPED OR PRINTED NAME OF PERSON MAILING PAPER)
LAURIE A. BOYLAN

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
10/018924	PCT/JP00/04166	YAM 2 0013

21. ☐ The following fees are submitted:	CALCULATIONS PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):	
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**	
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**	
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**	
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 890.00
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	14 - 20 =	0	x **$18.00**	$
Independent claims	3 - 3 =	0	x **$84.00**	$
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$280.00**	$
TOTAL OF ABOVE CALCULATIONS =				$
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2. +				$
SUBTOTAL =				$ 890.00
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$
TOTAL NATIONAL FEE =				$ 890.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$ 40.00
TOTAL FEES ENCLOSED =				$ 930.00
			Amount to be refunded:	$
			charged:	$

a. ☒ A check in the amount of $ 930.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 06-0308 A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
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SIGNATURE

Richard M. Klein
NAME

33,000
REGISTRATION NUMBER

"EXPRESS MAIL" Mailing Label Number EL852683386US
Date of Deposit December 19, 2001

10/031924
531 Rec'd PCT/PTO 19 DEC 2001

I hereby certify that this **Preliminary Amendment** is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to: BOX Patent Application, Assistant Commissioner of Patents, Washington, D.C. 20231.

Laurie A. Boylan
By: Laurie A. Boylan

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of
YANAGITA, Toshihiko

International Application No. PCT/JP00/04166
International Filing Date June 23, 2000

For: COMPOSITION FOR PROMOTING PASSIVE EXTENSION OF BLADDER SMOOTH MUSCLE

Attorney Docket No. YAM 2 0013

Cleveland, Ohio 44114
December 19, 2001

PRELIMINARY AMENDMENT

BOX Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to the examination of the merits and/or calculation of the fees, kindly amend the above-identified application as follows:

IN THE CLAIMS:

Please amend claims **8, 9, and 10** to read as follows:

8. (Amended) A composition according to claim 1, wherein the C-terminus of the adrenomedullin is amidated.

9. (Amended) A composition according to claim 1, wherein Gly is added to the C-terminus of the adrenomedullin.

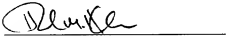
10. (Amended) A composition according to claim 1, wherein in the adrenomedullin, Cys in position 16 and Cys in position 21 of SEQ ID NO: 2 in SEQUENCE LISTING are crosslinked.

REMARKS

Entry of this preliminary amendment is requested at the U.S. Patent and Trademark Office's earliest convenience.

Respectfully submitted,

FAY, SHARPE, FAGAN,
MINNICH & McKEE, LLP

By: 

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Cleveland, Ohio 44114
Telephone: 216-861-5582
Facsimile: 216-241-1666
E-mail: *rklein@faysharpe.com*

Attachment - Version With Markings to Show Changes Made

lab429a.wpd

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Please amend claims **8, 9 and 10** (i.e. additions are underlined and deletions are bracketed) to read as follows:

IN THE CLAIMS:

8. (Amended) A composition according to [any of claims 1 and 4 to 7] claim 1, wherein the C-terminus of the adrenomedullin is amidated.

9. (Amended) A composition according to [any of claims 1 and 4 to 7] claim 1, wherein Gly is added to the C-terminus of the adrenomedullin.

10. (Amended) A composition according to [any of claims 1 and 4 to 7] claim 1, wherein in the adrenomedullin, Cys in position 16 and Cys in position 21 of SEQ ID NO: 2 in SEQUENCE LISTING are crosslinked.

"EXPRESS MAIL" Mailing Label Number EL852683386US
Date of Deposit: December 19, 2001

I hereby certify that this **Verified Statement Under 37 C.F.R. § 1.821(f)** is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Laurie A. Boylan

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF	:	YANAGITA, Toshihiko
FOR	:	**COMPOSITION FOR PROMOTING PASSIVE EXTENSION OF BLADDER SMOOTH MUSCLE**
SERIAL NO.	:	Unknown
FILED	:	Herewith
INTERNATIONAL APPLICATION NO.	:	PCT/JP00/04166
INTERNATIONAL FILING DATE	:	23 JUNE 2000
ATTORNEY DOCKET NO.	:	YAM 2 0013

Cleveland, Ohio 44114-2518
December 19, 2001

VERIFIED STATEMENT UNDER 37 C.F.R. § 1.821(f)

Box Patent Application
Assistant Commissioner for Patents
Washington, DC 20231

Dear Sir:

Herewith is a verified statement declaring that the information recorded on the enclosed diskette is identical to the information written sequence listing.

1. I hereby state that the information recorded in computer readable form is identical to the written sequence listing as required under 37 C.F.R. § 1.821(f).

2. I hereby state that the submission filed in accordance with 37

C.F.R. § 1.821(g), herein does not include new matter or matter which goes beyond the disclosure in the international application.

Respectfully submitted,

FAY, SHARPE, FAGAN
MINNICH & MCKEE, LLP

Date: 12/19/2001

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Cleveland, Ohio 44114-2516
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N:\YAM\20013\LAB0437A.WPD

PCT10

RAW SEQUENCE LISTING DATE: 01/17/2002
PATENT APPLICATION: US/10/018,924 TIME: 07:15:17

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C--> <141> CURRENT FILING DATE: 2001-12-19
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79                  75                  80                  85
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129 -30                 -25                 -20                 -15
131 Glu Asp Ser Ser Pro Asp Ala Ala Arg Ile Arg Val Lys Arg Tyr Arg
132                 -10                  -5                  -1   1
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135               5                  10                  15
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138      20                  25                  30
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RAW SEQUENCE LISTING DATE: 01/17/2002
PATENT APPLICATION: US/10/018,924 TIME: 07:15:17

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    176 Tyr Leu Gly Ser Leu Ala Phe Leu Gly Ala Asp Thr Ala Arg Leu Asp
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PATENT APPLICATION: US/10/018,924 TIME: 07:15:17

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RAW SEQUENCE LISTING DATE: 01/17/2002
PATENT APPLICATION: US/10/018,924 TIME: 07:15:17

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DESCRIPTION

COMPOSITION FOR PROMOTING PASSIVE EXTENSION OF BLADDER SMOOTH MUSCLE

TECHNICAL FIELD

The present invention relates to a composition for promoting extension of smooth muscle of the urinary bladder, comprising adrenomedullin.

BACKGROUND ART

Urinary incontinence is a common but very severe condition which mostly causes patients to be embarrassed, encounter difficulties, and be driven to despair. Clearly, there is a strong demand for a reliable and safe method of treating urinary incontinence. To date such a demand has not been satisfied to an appropriate level.

Urinary incontinence refers to a condition in which urine involuntarily flows out during the storage phase, and which is caused when there is a functional or organic abnormality in one or both of the urinary bladder and the urethra. Urinary incontinence occurs when bladder smooth muscle is involuntarily contracted so that the internal pressure of the urinary bladder is increased, or when urethral closure pressure created by the urethral sphincter and a supporting tissue surrounding the urethra is too weak to repel the internal pressure of the normal urinary bladder. Urinary incontinence is divided into several types depending on the pathology. Broad types are: urge incontinence; reflex incontinence; overflow incontinence

(poorly compliant bladder), stress incontinence, total incontinence; and nocturnal enuresis.

Urge incontinence is a condition in which urine involuntarily flows out accompanying a strong urge to urinate, or after feeling an urge to urinate, a patient cannot resist urine outflow and wets before reaching a toilet. These are divided into motor and sensory types. Motor urge incontinence is caused by a disorder of an inhibitory pathway for the micturition reflex, or excitation of an exitatory pathway, a representative example of which is neurogenic bladder due to a lesion, such as for example a cerebrovascular disorder and a brain tumor. Representative examples of sensory urge incontinence include cystitis and urethritis.

Reflex incontinence is a condition in which when the urinary bladder is filled with urine to some extent without a normal urge to urinate, the urinary bladder is reflectively contracted, so that urine involuntarily flows out. Reflex incontinence includes neurogenic bladder due to injury of the spinal cord above the urination center in the sacral spinal cord, urinary incontinence of infants, and the like.

Overflow incontinence is a condition in which since urine cannot be sufficiently excreted, the urinary bladder is excessively filled with urine and the urine gradually flows out. Overflow incontinence includes neurogenic bladder (poorly compliant bladder) due to injury of peripheral nerves, and disorders of the passage of the lower urinary tract due to prostatic hypertrophy or cancer.

Stress incontinence is a symptom in which when a

patient strains in sneezing or coughing, laughs, runs, or the like, so that abdominal pressure is rapidly increased, urine flows out without contraction of the urinary bladder. The increase in the abdominal pressure leads to a raise in the internal pressure of the urinary bladder. In this case, if the increased internal pressure exceeds the urethral closure pressure, urine flows out. Females more often suffer from this disorder. A major cause of stress incontinence is that supporting tissues surrounding the urethra are seriously weakened by parturition or aging, so that urethral closure pressure cannot be sufficiently generated.

Total incontinence is a condition characterized by dysfunction of the urethral sphincter, and in which urine flows out from the urethra at all times irrespective of the presence or absence of abdominal pressure. The cause of total incontinence is injury of the urethral sphincter caused by trauma of the pelvis or surgery of the prostate.

Nocturnal enuresis is also called bed-wetting, which is a condition in which patients of 4 or more years old, which is the age at which the habit of urinating is established, unconsciously void urine during sleep though they do not have an organic abnormality in the urinary tract or the nerve system and can urinate normally (no urinary incontinence) on awakening. This disorder is caused by the premature inhibitory mechanism of the central nerve system for the micturition reflex.

At present, anticholinergic agents are generally used for treatment of the following patients having urine storage disorders: (1) neurogenic bladder patients who have

urinary incontinence due to the hyperactivity of urinary bladder and involuntarily urinate; (2) neurogenic bladder patients who do not have abnormal urinary bladder contraction but have a poorly compliant urinary bladder in which the internal pressure of the urinary bladder gradually increased as urine is filled; (3) one subset of patients who chiefly complain of pollakiuria; etc. Clinically, despite the efficacy of anticholinergic agents against urine storage disorders, when the anticholinergic agents are actually used, urinary bladder contraction is inhibited in urination so that urination disorders are often exacerbated to cause side effects, such as increased residual urine and anuresis.

As described above, clearly, urinary incontinence is one of today's major diseases, but current therapeutic methods are not satisfactory. There is a demand for a novel drug for treating urinary incontinence. The term "urination disorder" as used herein refers to an abnormal urination condition, such as urinary incontinence, caused by insufficient extension of bladder smooth muscle. Examples of urination disorders include urinary incontinence (e.g., urge incontinence), frequent urination, nocturnal pollakiuria. An agent capable of promoting extension of bladder smooth muscle would be expected to help bladder smooth muscle extend during storage phase to reduce the internal pressure of the urinary bladder. Thus, such an agent would be considered to be useful as drugs for treatment of urinary incontinence and other symptoms relating to urination.

It has been known that adrenomedullin has a vasodilatory action. For example, Nakamura et al., Jpn. J.

Pharmacol. 67, 259-262 (1995) has reported in Figure 1 that contracted mesenteric artery is extended by addition of adrenomedullin in a concentration-dependent manner. However, vasodilation cannot be considered to be identical with passive extension of muscle of the urinary bladder. For example, Nishimura et al., British J. Pharmacology, 120, 193-200 (1997) describes in Figure 6 that addition of adrenomedullin to the urinary bladder does not cause contraction or extension (active extension) of the urinary bladder.

The present invention is intended to solve the above-described problems. The objective of the present invention is to provide a novel agent for promoting passive extension of bladder smooth muscle.

DISCLOSURE OF THE INVENTION

The inventions found that adrenomedullin originally identified as a peptide having a hypotensive action does not directly extend bladder smooth muscle, but has an action of promoting passive extension of the urinary bladder wall due to urine storage (i.e., an action of promoting extension of bladder smooth muscle) and based on that finding, completed the present invention.

Adrenomedullin does not inhibit contraction of the urinary bladder due to acetylcholine (i.e., urinary bladder contraction in urination) and therefore, can provide a therapeutic agent for ameliorating a urine storage disorder without inhibiting urinary bladder contraction in urination and substantially without side effects.

A composition of the present invention for promoting passive extension of bladder smooth muscle comprises adrenomedullin. The composition may be used to ameliorate a urination disorder. The urination disorder may be a urinary incontinence selected from the group consisting of urge incontinence, reflex incontinence, and overflow incontinence.

In one embodiment, the adrenomedullin may be any of the following peptides: (a) a petpide comprising an amino acid sequence from Ser in position 13 to Tyr in position 52 of SEQ ID NO: 2 in SEQUENCE LISTING; (b) a peptide comprising an amino acid sequence having one or several amino acid deleted, substituted, or added in the amino acid sequence (a), and having an action of promoting extension of bladder smooth muscle; (c) a petpide comprising an amino acid sequence from Tyr in position 1 to Tyr in position 52 of SEQ ID NO: 2 in SEQUENCE LISTING; (d) a peptide comprising an amino acid sequence having one or several amino acid deleted, substituted, or added in the amino acid sequence (c), and having an action of promoting extension of bladder smooth muscle; (e) a petpide comprising an amino acid sequence from Ala in position -73 to Tyr in position 52 of SEQ ID NO: 2 in SEQUENCE LISTING; (f) a peptide comprising an amino acid sequence having one or several amino acid deleted, substituted, or added in the amino acid sequence (e), and having an action of promoting extension of bladder smooth muscle; (g) a petpide comprising an amino acid sequence from Met in position -94 to Leu in position 91 of SEQ ID NO: 2 in SEQUENCE LISTING; and (h) a peptide comprising an amino acid sequence having one or several amino acid deleted, substituted, or added in the amino acid sequence (g), and having an action of promoting extension

of bladder smooth muscle.

In another embodiment, the C-terminus of the adrenomedullin may be amidated. Gly may be added to the C-terminus of the adrenomedullin.

In another embodiment, in the adrenomedullin, Cys in position 16 and Cys in position 21 of SEQ ID NO: 2 in SEQUENCE LISTING may be crosslinked. The crosslink may be a disulfide bond or a $-CH_2-CH_2-$ bond.

A method of the present invention for ameliorating a urination disorder uses a composition comprising adrenomedullin.

The present invention also provides use of adrenomedullin in production of a drug for ameliorating a urination disorder.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic diagram showing a method for dissecting the urinary bladder. As shown in Figure **1(a)**, ends of the urinary bladder were cut off along solid lines, and the urinary bladder was cut open along dashed lines. Four urinary bladder sections were obtained from the cut-open urinary bladder along three solid lines as shown in Figure **1(b)**.

Figure **2** is a graph showing the results of measurement of the effect of adrenomedullin on extension of the urinary bladder where the applied tension is 1 g. White circles indicate controls, while black circles

indicate the case of addition of adrenomedullin.

Figure 3 is a graph showing the results of measurement of the effect of adrenomedullin on contraction of the urinary bladder due to acetylcholine.

Figure 4 is a diagram showing the amino acid sequence of adrenomedullin derived from human pheochromocytoma. RE1 to RE6 indicate fragments produced by digesting the amino acid sequence with arginylendopeptidase.

BEST MODE FOR CARRYING OUT THE INVENTION

When carrying out the present invention, protein separation and analysis methods, recombinant DNA techniques, and assays, which are known in the art, may be employed unless otherwise specified.

I. Definition

Hereinafter, the terms used herein to explain the present invention will be described.

An "adrenomedullin" is a peptide having a hypotensive action, originally isolated from human pheochromocytoma. The term "adrenomedullin" as used herein is not limited to the particular peptide, but includes peptides having substantial homology in the amino acid sequence with that peptide. Examples of the homologous peptides include species mutants and allelic mutants. Human-derived adrenomedullin comprises an amino acid sequence from Tyr in position 1 to Tyr in position 52 of SEQ ID NO: 2 in SEQUENCE LISTING. (The peptide consisting

of an amino acid sequence from Met in position -94 to Leu in position 91 of SEQ ID NO: 2 in SEQUENCE LISTING is believed to be preproadrenomedullin. The peptide obtained by processing of a signal peptide and consisting of an amino acid sequence from Ala in position -73 to Leu in position 91 of SEQ ID NO: 2 in SEQUENCE LISTING is believed to be proadrenomedullin. The peptide consists of an amino acid sequence from Ser in position 13 to Tyr in position 52 of SEQ ID NO: 2 in SEQUENCE LISTING is an adrenomedullin fragment which has been confirmed to have a hypotensive action. Adrenomedullin in any of the above-described forms may be employed in the present invention.) Human-derived adrenomedullin may be encoded by a polynucleotide sequence from T in position 447 to C in position 602 of SEQ ID NO: 1 in SEQUENCE LISTING.

Porcine-derived adrenomedullin comprises an amino acid sequence from Tyr in position 1 to Tyr in position 52 of SEQ ID NO: 4 in SEQUENCE LISTING. Porcine-derived adrenomedullin may be encoded by a polynucleotide sequence from T in position 430 to C in position 585 of SEQ ID NO: 3 in SEQUENCE LISTING. Rat-derived adrenomedullin comprises an amino acid sequence from Tyr in position 1 to Tyr in position 50 of SEQ ID NO: 6 in SEQUENCE LISTING. Rat-derived adrenomedullin may be encoded by a polynucleotide sequence from T in position 433 to T in position 582 of SEQ ID NO: 5 in SEQUENCE LISTING.

Clearly, human-derived peptides are preferable for human diseases or treatment of a human. However, homologous peptides derived from other mammals may also be employed for some purposes. Further, comparison of human-derived peptides with peptides derived from other mammals is

important when an attempt is made to obtain a variant maintaining a desired activity of a human-derived peptide.

Adrenomedullin used in the present invention is not necessarily limited to the above-described sequences, but includes, as subjects, homologous peptides having an amino acid sequence which has one or several amino acid deleted, substituted, or added in the above-described sequences and maintaining a desired activity.

Amino acid conservative substitution is one preferable means for obtaining homologous peptides. Conservative substitution representatively includes substitutions conducted within the following groups: glycine, alanine; valine, isoleucine, leucine; aspartic acid, glutamic acid; asparagine, glutamine; serine, threonine; lysine, arginine; and phenylalanine, tyrosine.

The homology between two amino acid sequences is determined by optionally introducing a gap to optimize residue matching. A peptide having an amino acid sequence, which has substantially homology with the amino acid sequence of human adrenomedullin, has representatively about 60% homology with the amino acid sequence of human adrenomedullin, preferably at least about 70%, more preferably at least about 80%, and in an especially preferable embodiment, at least about 90% or more. Software for determining homology is easily available.

In the present invention, a peptide is by definition referred to "have an action of promoting extension of bladder smooth muscle" if the degree of extention of the urinary bladder is about 80% or more and preferably about 90% or

more of the value indicated in the experimental sample of Example 1 described below when measured under substantially the same conditions as those of Example 1 below.

The C-terminus of a peptide used in the present invention may or may not be amidated. "Amidation of C-terminus" refers to one of modification reactions of a peptide, in which the COOH group of the C-terminal amino acid of a peptide is changed to the form of $CONH_2$. A number of biologically active peptides functioning in vivo are first biosynthesized as a precursor protein having a larger molecular weight. The precursor protein is then matured by a modification reaction such as for example the amidation of the C-terminus. The amidation is conducted by a C-terminal amidating enzyme acting on the precursor protein. The precursor protein always includes a Gly residue on the C-terminal side of a residue to be amidated, which is frequently followed by a basic amino acid sequence pair, such as for example Lys-Arg or Arg-Arg, on the C-terminal side (Mizuno, Seikagaku, Vol. 61, No. 12, pp. 1435-1461 (1989)).

II. Adrenomedullin having an action of promoting extension of bladder smooth muscle

In the present invention, adrenomedullin is utilized as an effective component of a composition for promoting extension of bladder smooth muscle. Adrenomedullin is utilized as an effective component for manufacturing a drug for ameliorating a urination disorder. Adrenomedullin may be isolated from naturally-occurring sources, produced using recombinant DNA techniques, or chemically synthesized.

When adrenomedullin is isolated from naturally-occurring sources, purification may be conducted, for example, in the following way. For example, firstly human pheochromocytoma is pulverized to obtain a crude extract which is in turn subjected to various chromatography techniques for purification. In this case, by monitoring an increase in the cAMP activity of platelets, a fraction containing adrenomedullin of interest can be obtained. Method for isolation and purification of adrenomedullin are described in Japanese Laid-Open Publication No. 7-196693.

When adrenomedullin is produced using recombinant DNA techniques, the DNA sequence encoding a peptide of interest is expressed using various recombinant systems. Construction of expression vectors and preparation of transformants having appropriate DNA sequences are conducted by methods known in the art. Expression may be conducted using prokaryote systems or eukaryote systems.

Prokaryote hosts used include E.coli, bacillus, and other bacteria. For such prokaryote hosts, plasmid vectors having replication sites and control sequences compatible with the hosts are used. For example, E.coli is typically transformed with a derivative of pBR322 which is a plasmid derived from E.coli. The control sequence herein is defined to include a promoter for initiation of transcription, an operator if necessary, and a ribosome binding site. Such a control sequence includes generally used promoters such as for example β-lactamase and lactose promoter systems (Chang et al., Nature (1977) 198, 1056), tryptophan promoters (Goeddel et al., Nucleic Acids Res., (1980) 8: 4057), and P_L promoters derived from λ and N-gene ribosome binding sites (Shimatake, Nature (1981) 292, 128).

As a eukaryote host, yeast is used, for example. For such a host eukaryote, a plasmid vector having a replication site and a control sequence compatible with the host is used. For example, yeast is transformed with pYEUra3 (Clontech). Other promoters useful in a yeast host include, for example, promoter classes for synthesizing a glycolytic enzyme, such as for example a promoter for 3-phosphoglycerate kinase (Hitzeman et al., J. Biol. Chem. (1980) 255, 2073). Other promoters include those derived from an enolase gene or those derived from a Leu2 gene obtained from YEp13.

Appropriate mammalian promoters include metallothionein, an early or late promoter derived from SV40, and other virus promoters such as for example those derived from polyoma virus, adenovirus II, bovine papilloma virus and avian sarcoma virus.

A transformant can be obtained by introducing an expression vector into an appropriate host cell. A desired adrenomedullin can be obtained by culturing the transformant under appropriate conditions.

Chemical synthesis of adrenomedullin may be conducted within a method known in the art. For example, adrenomedullin may be synthesized by a solid phase method using a peptide synthesizer. A C-terminal amidated peptide can be synthesized on a peptide synthesizer by condensing amino acids sequentially from the C-terminal amino acid to the N-terminal amino acid using a benzhydryl amine resin and a standard DCC/HOBt, and cutting out an intended peptide from the resultant peptide resin by a standard cleavage

method (trifluoromethanesulfonic acid method).

A C-terminal amidated adrenomedullin may be obtained by one of the following: a carboxyl group at the C-terminus of the peptide obtained by expression in a host is chemically amidated; or a peptide is prepared so as to have Gly added to the C-terminus of an intended amino acid sequence, and is then allowed to react with the above-mentioned C-terminal amidating enzyme for amidation.

Alternatively, the peptide obtained by adding Gly to the C-terminus of adrenomedullin may be amidated due to an action of a C-terminal amidating enzyme in vivo as described above.

A disulfide bond can be formed, for example, by oxidizing a peptide by air oxidization or with an appropriate oxidant. The substitution of the disulfide bond can be conducted with a $-CH_2-CH_2-$ bond by a well-known method (O. Keller et al., Helv. Chim. Acta (1974) 57: 1253). Generally, cleavage in the disulfide bond is avoided by substituting a $-CH_2-CH_2-$ bond for the disulfide bond, resulting in stabilization of the protein.

Assay methods for action of promoting extension of bladder smooth muscle, which are known in the art, may be used to confirm that the thus-obtained adrenomedullin has an action of promoting extension of bladder smooth muscle. Examples of such assays include a method employing the urinary bladder isolated from any animal, and a method of measuring the internal pressure of the urinary bladder under anesthetization. When the urinary bladder isolated from a rat is used, for example, action of promoting extension of

bladder smooth muscle may be assayed under the following conditions. The urinary bladder is isolated from a rat and cut into several pieces to obtain urinary bladder strips. While the resultant urinary bladder strips are immersed in a buffer solution, such as for example Tyrode's solution, extension or contraction of the urinary bladder is continuously examined using a measuring apparatus, such as for example an isometric transducer and an isotonic transducer. The urinary bladder is allowed to be extended in the presence or absence of a subject peptide, and extension of the urinary bladder is compared between the two cases to judge whether or not the peptide has an action of promoting extension of bladder smooth muscle.

III. Preparation of a composition for promoting extension of bladder smooth muscle

A composition of the present invention comprises an effective amount of adrenomedullin and may further comprise any excipient known to those skilled in the art. Examples of the excipients include lactose, cornstarch, magnesium stearate, and alum.

The composition of the present invention is prepared in accordance with methods known in the art.

The composition of the present invention may be in any form. The composition of the present invention may be a solid, such as for example a tablet, a pill, a capsule, and a granule; or a liquid, such as for example an aqueous solution and a suspension. When the composition of the present invention is orally administered as a tablet, an excipient, such as for example lactose, cornstarch, and magnesium stearate, may be commonly used. When the

composition of the present invention is orally administered as a capsule, an excipient, such as for example lactose and dried cornstarch, may be commonly used. In order to orally administer adrenomedullin as an aqueous suspension, the adrenomedullin may be used in combination with an emulsion or a suspension. The aqueous suspension may optionally contain a sweetner and an aroma chemical. When the composition of the present invention is intramuscularly, intraperitoneally, subcutaneously, or intravenously injected, adrenomedullin is dissolved in a sterilized solution to prepare a buffer solution which is in turn adjusted into an appropriate pH. When the composition of the present invention is intravenously administered, the composition is preferably isotonic.

The composition of the present invention may be used as a drug for ameliorating a urination disorder.

IV. Administration of a composition for promoting extension of bladder smooth muscle

The composition of the present invention may be administered in the form of a conventional peptide formulation as described in Remington's Pharmaceutical Sciences, Mack Publishing, Easton, PA. For example, the composition of the present invention may be administered orally, or alternatively parenterally, such as for example intravenous administration, intramuscular injection, intraperitoneal injection, and subcutaneous injection. The peptide may be administered by injection into the urinary bladder.

When the composition of the present invention is administered into a human subject, typically, the dose per

day can be appropriately determined by those skilled in the art by taking into consideration a patient's symptoms, severity, individual differences in sensitivity, weight, age, and the like. The composition of the present invention may be administered once a day or several times a day.

Urination disorders would be ameliorated by administration of the composition of the present invention.

(Examples)

Hereinafter, the action of adrenomedullin of the present invention as a drug for promoting extension of bladder smooth muscle will be more specifically described. The present invention is not limited to the following examples. Adrenomedullin used in the examples is a synthesized peptide consisting of an amino acid sequence from Tyr in position 1 to Tyr in position 50 of SEQ ID NO: 6 (available from Peptide Institute, Inc.).

(Example 1: Effect of adrenomedullin on extension of the urinary bladder of a male rat)

8 to 16 weeks old male rats were sacrificed by hammering their heads. Thereafter, the rats were decapitated, followed by exsanguination. The urinary bladders were isolated from the rats. Each isolated urinary bladder was cut into four portions, thereby obtaining urinary bladder strips (Figure 1).

The effect of adrenomedullin on the rat urinary bladder was examined by measuring contractions of the urinary bladder strips using an isotonic transducer TD-112S (manufactured Nippon Kohden Corporation) where the tension was 1 g.

The urinary bladder strips were firstly immersed in 30 ml of Tyrode's solution with 100 nM adrenomedullin (experimental sample) or without it (control sample). In this situation, the sections were attached to the isometric transducer where the tension was 1 g, to continuously measure relaxation of the urinary bladder. The composition of the Tyrode's solution is as follows: 139 mM NaCl, 2.7 mM KCl, 11.9 mM $NaHCO_3$, 2.6 mM $MgCl_2 \cdot 6H_2O$, 0.4 mM $NaH_2PO_4 \cdot 2H_2O$, 1.7 mM $CaCl_2$, and 5.5 mM glucose; pH 7.4).

The above-described experiment was repeated five times. The results are shown in Figure 2. Solid colored circles indicate the results of the experimental sample, while plain circles indicate averages of the control sample. Vertical bars indicate the standard deviation of a two-way analysis of variance. The vertical axis indicates the length of relaxation (mm), while the horizontal axis indicate time (minutes).

As shown in Figure 2, when tension was applied to the urinary bladder in the presence of adrenomedullin to cause the urinary bladder to be extended, the result obtained is that the urinary bladder wall was more extended compared to the case of the absence of adrenomedullin. Normally, the urinary bladder is passively extended by urine filling therein during the urine storage phase, and the extension prevents the internal pressure of the urinary bladder from being increased, so that the internal pressure of the urinary bladder remains at a constant low value. A high expansibility of the urinary bladder is referred to as a high level of compliance. As a result of this example, it was demonstrated that adrenomedullin causes the urinary

bladder to remain in a higher compliance state during the urine storage phase, thereby increasing the capacity of the urinary bladder.

(Example 2: Effect of adrenomedullin on static tension, and contraction due to acetylcholine of the urinary bladder of a male rat)

Urinary bladder strips were prepared in a manner similar to that of Example 1. The urinary bladder sections were attached to an isometric transducer FD pickup TB611T (manufactured by Nippon Kohden Corporation) in Tyrode's solution. Contraction of the urinary bladder was continuously measured. Firstly, 30 nM to 1 mM acetylcholine was added to the Tyrode's solution. As a result, contraction of the urinary bladder occurred (Figure 3). In Figure 3, the vertical axis indicates tension (unit: g), while the horizontal axis indicates time. Contraction induced by acetylcholine was confirmed, followed by washing out acetylcholine. Thereafter, 100 nM adrenomedullin was added to the Tyrode's solution. As a result, the urinary bladder was not contracted. Further, 30 nM to 1 mM acetylcholine was added to the Tyrode's solution. As a result, recontraction of the urinary bladder occured. The contraction induced by acetylcholine alone before the addition of adrenomedullin was not significantly different from the contraction induced by acetylcholine in the presence of adrenomedullin.

Therefore, the tested adrenomedullin did not affect the static tension of the urinary bladder, or exhibit an effect of preventing contraction of the urinary bladder due to acetylcholine, which is believed to correspond to contraction of the urinary bladder during a voiding phase.

INDUSTRIAL APPLICABILITY

According to the present invention, a composition for promoting extension of bladder smooth muscle, comprising adrenomedullin is provided. Such a composition is useful for ameliorating a urination disorder selected from the group consisting of urge incontinence, reflex incontinence, and overflow incontinence.

CLAIMS

1. A composition for promoting passive extension of bladder smooth muscle, comprising adrenomedullin.

2. A composition according to claim 1, used to ameliorate a urination disorder.

3. A composition according to claim 2, wherein the urination disorder is a urinary incontinence selected from the group consisting of urge incontinence, reflex incontinence, and overflow incontinence.

4. A composition according to claim 1, wherein the adrenomedullin is:

(a) a petpide comprising an amino acid sequence from Ser in position 13 to Tyr in position 52 of SEQ ID NO: 2 in SEQUENCE LISTING; or

(b) a peptide comprising an amino acid sequence having one or several amino acid deleted, substituted, or added in the amino acid sequence (a), and having an action of promoting extension of bladder smooth muscle.

5. A composition according to claim 4, wherein the adrenomedullin is:

(c) a petpide comprising an amino acid sequence from Tyr in position 1 to Tyr in position 52 of SEQ ID NO: 2 in SEQUENCE LISTING; or

(d) a peptide comprising an amino acid sequence having one or several amino acid deleted, substituted, or added in the amino acid sequence (c), and having an action of promoting extension of bladder smooth muscle.

6. A composition according to claim 5, wherein the adrenomedullin is:

(e) a petpide comprising an amino acid sequence from Ala in position -73 to Tyr in position 52 of SEQ ID NO: 2 in SEQUENCE LISTING; or

(f) a peptide comprising an amino acid sequence having one or several amino acid deleted, substituted, or added in the amino acid sequence (e), and having an action of promoting extension of bladder smooth muscle.

7. A composition according to claim 6, wherein the adrenomedullin is:

(g) a petpide comprising an amino acid sequence from Met in position -94 to Leu in position 91 of SEQ ID NO: 2 in SEQUENCE LISTING; or

(h) a peptide comprising an amino acid sequence having one or several amino acid deleted, substituted, or added in the amino acid sequence (g), and having an action of promoting extension of bladder smooth muscle.

8. A composition according to any of claims 1 and 4 to 7, wherein the C-terminus of the adrenomedullin is amidated.

9. A composition according to any of claims 1 and 4 to 7, wherein Gly is added to the C-terminus of the adrenomedullin.

10. A composition according to any of claims 1 and 4 to 7, wherein in the adrenomedullin, Cys in position 16 and Cys in position 21 of SEQ ID NO: 2 in SEQUENCE LISTING are crosslinked.

11. A composition according to claim 10, wherein the crosslink is a disulfide bond.

12. A composition according to claim 10, wherein the crosslink is a $-CH_2-CH_2-$ bond.

13. A method for ameliorating a urination disorder using a composition comprising adrenomedullin.

14. Use of adrenomedullin in production of a drug for ameliorating a urination disorder.

FIG. 1

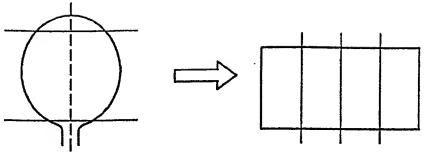
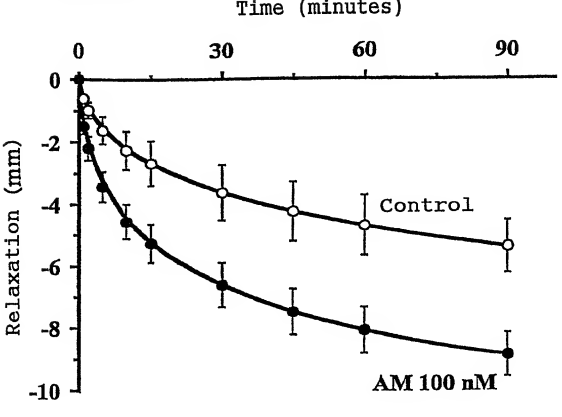


FIG. 2


Time (minutes)
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Relaxation (mm)
Control
AM 100 nM

FIG. 3

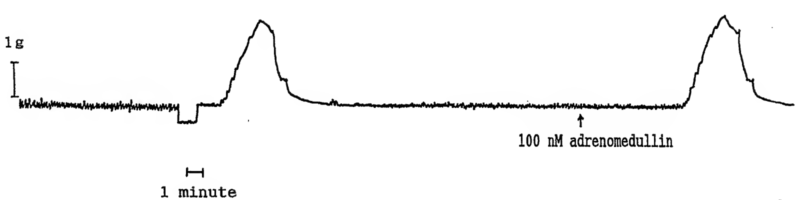
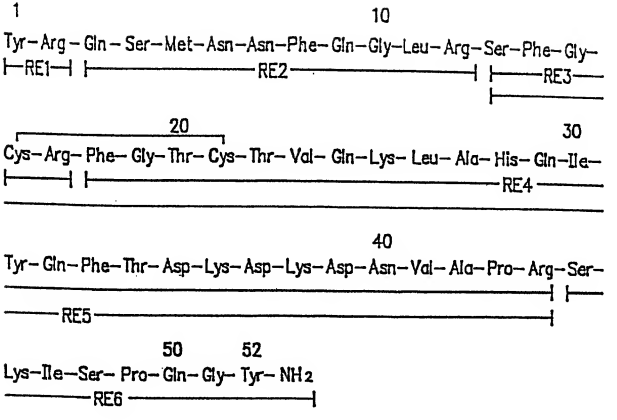

* Contraction induced by addition of acetylcholine is not significantly influenced by the presence of adrenomedullin.
Contraction induced by acetylcholine
(30nM~1mM)
Contraction induced by acetylcholine in the presence of 100 nM adrenomedullin
(30nM~1mM)
1 g
100 nM adrenomedullin
1 minute
Static tension is not changed by adrenomedullin alone.

FIG. 4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RE2
RE3
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Cys–Arg–Phe–Gly–Thr–Cys–Thr–Val–Gln–Lys–Leu–Ala–His–Gln–Ile–
RE4
40
Tyr–Gln–Phe–Thr–Asp–Lys–Asp–Lys–Asp–Asn–Val–Ala–Pro–Arg–Ser–
RE5
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Lys–Ile–Ser–Pro–Gln–Gly–Tyr–NH2
RE6

SEQUENCE LISTING

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cag atc tac cag ttt aca gac aaa gac aag gac ggc atg gcc ccc aga   558
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Please type a plus sign (+) inside this box → [X]

PTO/SB/01 (12-97)
Approved for use through 9/30/00. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)	Attorney Docket Number	YAM 2 0013
	First Named Inventor	Toshihiko YANAGITA
	COMPLETE IF KNOWN	
	Application Number	/
	Filing Date	
[X] Declaration Submitted with Initial Filing OR [ ] Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)	Group Art Unit	
	Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

COMPOSITION FOR PROMOTING PASSIVE EXTENSION OF BLADDER SMOOTH MUSCLE

(Title of the invention)

the specification of which
[ ] is attached hereto
OR
[X] was filed on (MM/DD/YYYY) 06/23/2000 as United States Application Number or PCT International Application Number PCT/JP00/04166 and was amended on (MM/DD/YYYY) [ ] (Article 34) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	Certified Copy Attached? NO
11-177549	JAPAN	06/23/1999	[ ]	[ ]	[X]
			[ ]	[ ]	[ ]
			[ ]	[ ]	[ ]
			[ ]	[ ]	[ ]

[ ] Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

[ ] Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

Please type a plus sign (+) inside this box → [X]

PTO/SB/01 (12-97)
Approved for use through 9/30/00. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (If applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number OR [X] Registered practitioner(s) name/registration number listed below → Place Customer Number Bar Code Label here

Name	Registration Number	Name	Registration Number
Richard M. Klein	33,000		

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label [ ] OR [X] Correspondence address below

Name	Richard M. Klein				
Address	FAY, SHARPE, FAGAN, MINNICH & McKEE, LLP				
Address	1100 Superior Avenue, Seventh Floor				
City	Cleveland	State	OH	ZIP	44114
Country	U.S.A.	Telephone	(216) 861-5582	Fax	(216) 241-1666

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Toshihiko	YANAGITA

Inventor's Signature	Toshihiko Yanagita					Date	3/10/01
Residence: City	Miyazaki-shi	State	Miyazaki	Country	JAPAN	Citizenship	JAPAN
Post Office Address	5-10 Banbelhouse A-401, 940, Oaza Tsunehisa						
Post Office Address							
City	Miyazaki-shi	State	Miyazaki	ZIP	880-0916	Country	JAPAN

☐ Additional inventors are being named on the ____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto